REMARKS

The above amendments to the above-captioned application along with the following remarks are being submitted as a full and complete response to the Official Action dated May 6, 2003.

Claims 1-20 are under consideration in this application. Claims 1-2, 12-13 and 15 are being amended, as set forth above and in the attached marked-up presentation of the claim amendments, in order to more particularly define and distinctly claim applicants' invention. Applicants hereby submit that no new matter is being introduced into the application through the submission of this response.

In view of the above amendments and the following remarks, the Examiner is respectfully requested to give due reconsideration to this application, to indicate the allowability of the claims, and to pass this case to issue.

Prior Art Rejections

Claims 1-20 were rejected under 35 U.S.C. § 103(a) on the grounds that the claims are unpatentable over U.S. Pat. App. Pub. No. 2002/0058414 by Derderian et al (hereinafter "Derderian"), in view of the prior art references stated in the present application (hereinafter "AAPA"). This rejection has been carefully considered, but is most respectfully traversed.

The fabricating method of a semiconductor integrated circuit of the invention, as now recited in claim 1, comprises forming a ruthenium electrode of a capacitor with high-k material on a semiconductor substrate by a chemical vapor deposition method in a sub-atmospheric pressure using an organoruthenium compound as a precursor, which includes: a first step of providing the semiconductor substrate in a deposition chamber, increasing a temperature of the semiconductor substrate in the chamber up to a desired temperature; a second step of supplying the precursor into the deposition chamber to form a ruthenium film with a desired thickness on the heated semiconductor substrate; a third step of stopping the supply of the precursor and decreasing the temperature of the semiconductor substrate; and a fourth step of separately supplying an *oxidation gas* into the deposition chamber from said *precursor* such that the supply of the oxidation gas is **separately controlled** and **only during** the precursor-supplying step (Figs.

1-4). For example, in the Embodiment 2 (page 20, lines 12-25), "*a precursor gas, an oxidation gas, and an inert gas are introduced to form a bottom electrode of ruthenium.... The gas introduction sequence for forming the ruthenium film with least oxygen contamination shown in FIG. 2.*" In particular, "*$Ru(C_5H_4C_2H_5)_2$* (precursor) *is heated and vaporized by a vaporizer held at 150 °C, and carried by using a nitrogen gas as a carrier gas*" such that the carrier gas of the precursor (supplied from minute 0 to minute 17 in Fig. 2) and the oxygen gas (supplied from minute 4- minute15 in Fig. 2) cab be separately controlled to be supplied at different time points.

The invention, as now recited in claim 12, is directed to a fabricating method of a semiconductor integrated circuit comprising: forming a bottom electrode of ruthenium of a capacitor with high-k material on a semiconductor substrate by a chemical vapor deposition method in a sub-atmospheric pressure using an organoruthenium compound as a precursor; and immediately thereafter performing annealing at not less than a formation temperature of the bottom electrode of ruthenium in a reducing atmosphere containing hydrogen thereby inhibiting deformation of crystal grains of the bottom electrode of ruthenium in the annealing step during or after capacitor insulator formation. For example, in the Embodiment 5 (page 32, lines 2-4), "*by performing annealing thereof at 400 °C for 2 minutes in an atmosphere containing 3 % hydrogen in a nitrogen gas. The annealing in a reducing atmosphere containing hydrogen or the like can remove the oxygen left in a slight amount in the film*".

The key purpose of the invention is to reduce oxygen in a ruthenium film. In the producing a ruthenium electrode using a organoruthenium material as material gas by CVD method as recited in claim 1, the key purpose is achieved via (1) limiting the introduction of a oxidizing gas in a material gas introduction period, (2) reacting a material gas under a condition of low partial pressure of oxygen, and (3) separately controlling an oxidizing gas supply form the carrier gas supply (page 19, lines 5-20; page 17, lines 20-25; Fig. 7). In the method recited in claim 12, the key result is achieved via taking out oxygen of a ruthenium film by annealing in a reducing atmosphere after deposition of ruthenium electrode (page. 31, line 21 to page 32, line 5) thereby making a ruthenium film with low oxygen content and stable in thermal treatment.

Applicants respectfully contend that neither Derderian nor AAPA, or their combination as relied upon by the Examiner, teaches or suggests the features of (a) a "step of separately supplying an *oxidation gas* into the deposition chamber from said *precursor* such that the supply of the oxidation gas is **separately controlled** and **only during** the precursor-supplying step"; or (b) "immediately thereafter performing annealing at not less than a formation temperature of the

bottom electrode of ruthenium in a reducing atmosphere containing hydrogen thereby inhibiting deformation of crystal grains of the bottom electrode of ruthenium in the annealing step during or after capacitor insulator formation".

Regarding the (a) feature, the Examiner relied upon the description on page 7, paragraph [0076] of Derderian to teach using an oxygen gas as a carrier gas such that the oxygen gas is supplied **only during** the precursor-supplying step (page 2, lines 16-17 of the outstanding office action). In this case, the oxygen gas supply is stopped so as to stop the precursor supply such that that oxidizing gas and the carrier gas are NOT separately controlled to be supplied as recited in claim 1.

Regarding the (b) feature, the Examiner simply failed to address claim 12. Derderian anneals after formation of a ruthenium film (page 5, paragraphs [0058]-[0059]) in an annealing atmosphere of oxygen, ozone, argon, nitrogen (pp.5 paragraph 59), but not of hydrogen. This is because Derderian intends to enhance the surface roughness of the ruthenium film by annealing, rather than to reduce oxygen in the ruthenium film as in the invention. Derderian does not concern nor suggest annealing for reducing oxygen in a ruthenium film.

Regarding the Examiner's allegation that there is no evidence indicating that the average crystal grain size of the bottom electrode of ruthenium is critical, Applicants contend that "*by performing annealing at not less than the formation temperature, the size of each crystal grain increases, and the crystal grains become* ***uniform*** *with an average grain size of 40 nm, while ranging from 30 nm to 60 nm, at 400 °C*" (page 13, lines 19-21; Fig. 10).

Applicants contend that neither Derderian, AAPA, nor their combination teaches or discloses each and every feature of the present invention as disclosed in independent claims 1 and 12. As such, the present invention as now claimed is distinguishable and thereby allowable over the rejections raised in the Office Action. The withdrawal of the outstanding prior art rejections is in order, and is respectfully solicited.

In view of all the above, clear and distinct differences as discussed exist between the present invention as now claimed and the prior art reference upon which the rejections in the Office Action rely, Applicants respectfully contend that the prior art references cannot anticipate the present invention or render the present invention obvious. Rather, the present invention as a whole is distinguishable, and thereby allowable over the prior art.

Favorable reconsideration of this application is respectfully solicited. Should there be any outstanding issues requiring discussion that would further the prosecution and allowance of the above-captioned application, the Examiner is invited to contact the Applicants' undersigned representative at the address and phone number indicated below.

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